



Langley Research Center

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FACILITY SAFETY REQUIREMENTS

National Aeronautics and Space Administration

Responsible Office: Office of Safety, Environment and Mission Assurance

PREFACE

This Langley Procedural Requirements (LPR), a part of the Langley Research Center (LaRC) Safety Manual, sets forth LaRC policy, procedures, and criteria for facility safety requirements. These policies are supported by the regulations and standards established by the American National Standards Institute (ANSI), the Occupational Safety and Health Administration (OSHA), and the National Aeronautics and Space Administration (NASA).

LAPG 1740.2, dated July 1999, is rescinded and should be destroyed.

Wallace C. Sawyer
Deputy Director

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SDL 040, SDL 043, SDL 410, and SDL 412

(LaRC Safety Manual Holders)

429/Office of Safety and Facility Assurance, OSEMA (50 copies)

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Chapter 1**1. INTRODUCTION****1.1 GENERAL**

It is LaRC policy to provide a safe and healthful work environment for all employees. To this end, all LaRC employees are charged with the responsibility for ensuring a safe and healthful workplace. Every employee is required to notify line supervision, without fear of disciplinary action or any other form of retaliation, of any hazardous condition where employee injury or equipment damage may result. When notified, a first-line supervisor is responsible for investigating any safety concern raised and for initiating corrective action. Reprisals or disciplinary actions against an employee initiating a safety concern will not be tolerated.

OSEMA is available to assist employees and line management with correcting deficiencies and ensuring that LaRC remains a safe and healthful place to work. OSEMA assistance can be obtained by calling extension 4-SAFE.

1.2 PURPOSE

This LPR defines minimum safety standards which are required at each facility under LaRC management. These minimum requirements are based on Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI) standards and establish baseline facility safety requirements. They do not replace requirements in existing LaRC directives.

1.3 SCOPE

This LPR contains the LaRC approach to safe practices and requirements. It identifies potentially dangerous and hazardous situations, and references the proper directive for treatment of such situations.

1.4 CONTRACTOR APPLICATION AND COMPLIANCE

Contractors will apply the minimum safety requirements contained in this LPR to work done at LaRC. These minimum safety requirements are also specifically defined in SPECSINTACT and are to be included in contract specifications for work to be performed at LaRC.

Contractor personnel must be appropriately trained regarding the safety aspects of work performed throughout LaRC.

Contractors are responsible for supplying special equipment and/or supplies required to safely perform work throughout LaRC.

Chapter 2**2. HAZARD IDENTIFICATION AND MARKINGS****2.1 GENERAL**

All Center facilities receive an annual Occupational Safety and Health Audit in order to identify hazards. Audit results are provided to the Facility Safety Head (FSH). If corrective action is required, the FSH must provide closure and post the audit until the discrepancy is closed. If the facility staff cannot correct discrepancies, a LaRC Work Request (Form 69) is used to provide closure. The original Work Request, with the audit response, is forwarded to OSFA for tracking until closure. The scheduled completion of all work requests will be coordinated with the responsible FSH and tracked by the Systems Engineering Competency.

The following personnel are responsible for assuring compliance with the requirements of this section:

- Existing Systems - FSHs and/or Facility Coordinators (FCs).
- New Systems - Design engineers, Technical Project Engineers (TPEs), and/or other personnel directly charged with the acquisition of new hardware.

2.2 UTILITY AND RESEARCH SYSTEMS

Identification of research apparatus, support equipment, and building/facility utilities is mandatory whenever the lines, pipes, components, or vessels are accessible during normal operations or maintenance activities. Identification is accomplished by legends and color coding of the system as described herein. For the purposes of this section, the following systems are excluded from the definitions of utilities:

- Electrical conduit.
- Instrumentation cables.
- Heat/air conditioning ducts.

Utility tunnels are to have markings immediately inside each entrance noting their location.

2.2.1 System Identification

System (function) identification is necessary in order to isolate the system, or a portion of the system, for purposes of operation and maintenance. Schematic layouts, together with condensed operating instructions, will be prepared for each system and/or subsystem. These layouts and operating instructions should be included in relevant Facility documentation.

2.2.2 Hazard Identification

The use of legends and colors has been determined to be the most effective means of alerting personnel to the hazards involved in the operation and maintenance of

utility and research systems. Labels and legends are mandatory at LaRC. The use of color codes (in the form of bands) is desirable when and where appropriate, primarily when highly toxic or flammable media are involved. (See Appendix A for legend and color code details; see paragraph 2.4, Physical Hazards, this Chapter, where physical hazards are also involved.)

2.2.3 Legends

Tags, decals, or stencils will be employed to identify pipe or feed line media and direction of flow. Additionally, pressures and temperatures will be identified where appropriate. Specifically, the requirements of this section are supplemented when high pressure systems are involved (see LPR 1710.40, "Safety Regulations Covering Pressurized Systems"). Banding of pipe markers now in use provides instant 360° location of each decal or legend. Legends should be located approximately every 50-75 feet along continuous lines, on all branches at T joints, wherever lines pass through walls, and so forth. Arrows will indicate direction of flow and point away from the legend. If flow is in both directions, double headed arrows should be used. The legend sizes to be used are illustrated in Figure 2.1. (Figure 2.1, next page, also shows typical arrows and media identification.) Small tags or signs with 1/2 inch lettering may be attached to pipes or vessels under 1/2 inch in size.

All new or replacement legends will be stenciled. If used, color bands should be painted.

2.2.4 Color Coding

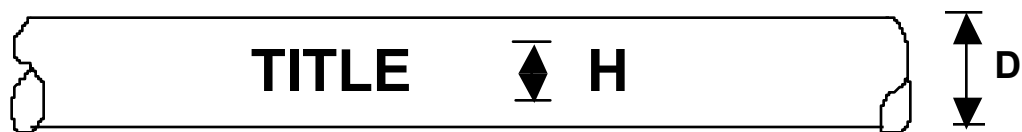
The colors used to signify the various general hazards are based on ANSI 53.1, latest revision. Color bands, spaced at prominent locations along the pipe or device, are considered most appropriate. The general color scheme of the ANSI Code is shown in Figure 2-2 (see Appendix A for specific application to LaRC).

2.2.5 Responsibilities

The following personnel are responsible for assuring compliance with the requirements of this section:

- Existing Systems - Facility Safety Heads (FSHs) and/or Principal Facility Coordinators (FCs).
- New Systems - Design engineers, Technical Project Engineers (TPEs), and/or other personnel directly charged with the acquisition of new hardware.

LEGENDS



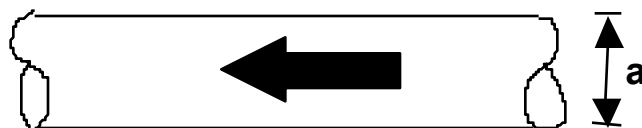
D
(DIAMETER IN INCHES)

H
(HEIGHT IN INCHES)

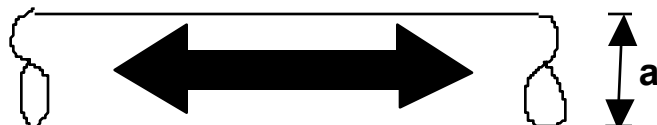
UNDER 1/2 "
 1/2 " to 3 "
 3 " and over

1/2 "
1-1/8 "
2-1/4 "

ARROWS



ONE DIRECTION



REVERSIBLE

MEDIUM AND STATE

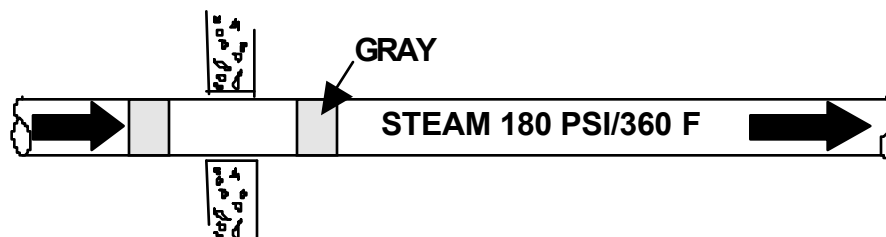


Figure 2.1, Legends

<u>Color Name</u>	<u>Hazard Identification</u>
Yellow	Flammable materials. All materials known ordinarily as flammables or combustibles.
Brown	Toxic and poisonous materials. All materials extremely hazardous to life or health under normal conditions.
Blue	Anesthetics and harmful materials and electrical voltages. All materials productive of anesthetic vapors and all liquid chemicals and compounds hazardous to life and property but normally productive of dangerous quantities of fumes or vapors, and electrical voltage of 600 volts or greater.
Green	Oxidizing materials. All materials which readily furnish oxygen for combustion and fire producers which react explosively, or material which, when in contact with many other materials, can cause spontaneous combustion.
Red	Fire protection materials. All materials provided in piping systems or in compressed gas cylinders exclusively for use in fire protection.
Gray	Physically dangerous materials. All materials not dangerous of themselves but which are asphyxiating in confined spaces, or which are generally handled in a dangerous physical state of pressure or temperature (over 200° F and under 0° F).

Figure 2.2, General Color Scheme of the ANSI Code

2.3 UNDERGROUND UTILITIES

Mylar detectable tape or its equivalent will be used in all installations and maintenance tasks for buried underground facilities at LaRC, to include laying detectable tape approximately 6 inches below the surface of the ground directly above buried utility lines. This policy is consistent with OSHA regulations which stipulate that personnel will be protected from hazards created by excavating or trenching in the vicinity of dangerous underground facilities.

Excavation or other surface penetration activity (including landscaping) performed on LaRC premises either by in-house or contractor personnel presents a potential safety hazard. Accordingly, a "Digging Permit" system has been developed to control actual or potential disturbance of existing surfaces to a depth in excess of 6 inches. The Underground Utilities Coordinator, Systems Engineering Competency, has been designated as the focal point for control of the buried/underground utility systems at this Center. Digging permits (Figure 2.2,) will be issued by the Underground Utilities

- NASA-LaRC - <u>D I G G I N G P E R M I T</u>	
<small>THE ISSUANCE OF THIS PERMIT DOES NOT REDUCE THE CONTRACTOR'S LIABILITY FOR DAMAGE DONE TO DRAWING-IDENTIFIED GOVERNMENT PROPERTY WHICH MAY OCCUR DURING EXCAVATION.</small>	
COMPANY _____	
LOCATION _____ SAMPLE _____	
ESTIMATED PERIOD - START _____ STOP _____	
UTILITIES DWGS. ISSUED TO _____ DATE _____	
DESIGNATED CONTRACTING OFFICER'S REPRESENTATIVE OR INSPECTOR	
NAME _____ DEPT. _____ PHONE _____	
UNDERGROUND UTILITIES COORDINATOR APPROVAL _____	
_____ DATE _____	

Figure 2.3, NASA LaRC Digging Permit

Coordinator upon request. Early identification of excavation/penetration requirements will assist the Underground Utilities Coordinator in planning drawings and survey support efforts.

It is the responsibility of the designated Contracting Officer's representative or inspector to assure the following steps are performed in connection with actual "digging" operations of contractors at LaRC:

- Notify the Underground Utilities Coordinator at least 24 hours in advance with the specific details.
- Coordinate a specific time prior to the start of excavation operations to meet with the contractor and LaRC survey personnel at the work site. Survey personnel will mark all existing utilities, provide the contractor with current work site utility drawings, and issue the Digging Permit.

- Verify that the contractor conforms to all published requirements during the excavation/penetration process (including appropriate barricades and warnings) and prominently displays this authorization.
- Notify the Underground Utilities Coordinator (or agents) prior to back fill so that affected documents can be verified and/or red lined.
- Remove and return the sign and permit to the Systems Engineering Competency, at the completion of the operation if the Underground Utilities Coordinator (or agents) have not already done so.

2.4 PHYSICAL HAZARDS

This section recognizes the dangers resulting from people being too close to physical hazards, and provides a LaRC system of marking and color coding.

2.4.1 Color Coding

For each type of hazard identified, a specific color is required as specified:

<u>Color</u>	<u>Hazard Identification</u>
Red	Fire protection equipment and apparatus. Containers for flammable liquids having a flashpoint below 100° F. Emergency stop bars or buttons on hazardous machines.
Orange	Dangerous parts of machinery or energized equipment which may cut, crush, shock, or otherwise injure. Enclosure doors are open or when gear belts or other guards around the moving equipment are open or removed, exposing unguarded hazards.
Yellow	Caution and for marking physical hazards such as falling, stumbling, striking against, tripping, or getting caught in between objects. Solid yellow, yellow and black stripes, yellow and black checkers (or yellow with suitable contrasting background) should be used interchangeably, and using a combination which will attract the most attention in the particular environment.
Green	"Safety" and the location of First Aid equipment (except fire fighting equipment).
Blue	Warning against the starting, the use of, or the movement of equipment under repair or being worked on.
Magenta (Purple and Yellow)	Radiation hazards.
Black, White, or a Combination	Traffic and household markings. Solid black, solid white, single color striping, stripes of black and white, or black and white checkers should be used in accordance with local conditions.

2.4.2 Identification Clarification

In general, the use of color coding is intended to identify the immediate area where the physical hazard exists. Consequently, excessive use of warning color (overpaint) defeats the identification of the specific hazard and tends to make the program ineffective. Further, multiple hazard identification requirements must have a criteria for determining precedents. The LaRC standard is that the most serious hazard determines the appropriate color coding, as shown by the following examples:

- Where no physical hazard exists, black and white are used for housekeeping walkways and work areas. However, when physical hazards intrude into these spaces, yellow or combination yellow and black is to be used for marking.
- When a utility or research system also represents a physical hazard, the physical hazard color coding represents the overriding requirement. The piping or device is to have a legend and be painted yellow or yellow and black. Also, utility color bands at appropriate intervals may be added to the basic physical hazard color where appropriate.

2.5 POTENTIALLY HAZARDOUS MATERIALS

Communications concerning hazardous chemicals and their safe use are extremely important. Hazard awareness is increased through the use of warning labels. The use of color codes reduces the danger to the individual by enabling the person to immediately identify and evaluate the hazard/risk posed by the various materials stored or being used. Therefore, personnel engaged in tasks requiring the use of potentially hazardous materials must have a good working knowledge and understanding of the criteria and requirements outlined in LPR 1710.12, "Potentially Hazardous Materials." OSHA mandated Hazard Communication and Chemical Laboratory Safety Standards are also outlined in LPR 1710.12 as well as requirements for permits for use of hazardous materials.

The type of risk is identified by color (blue--health; red--flammability; yellow--reactivity; and white--other hazards). The degree of danger is determined on a scale of 0 to 4; with 0 representing minimal danger and 4 indicating extreme danger, possibly death. This identification system is further described in LPR 1710.12 and in National Fire Protection Association (NFPA) 704, "Standard System for the Identification of the Hazards of Materials for Emergency Response." Additional information and assistance is available from the Office of Safety and Facility Assurance (OSFA), Office of Safety, Environment and Mission Assurance (OSEMA), particularly for instances involving contractor activities.

2.6 ALLOWABLE FLOOR LOADS

The Center's annual OSHA inspection will determine the initial need for allowable floor load identification. Thereafter, each FSH and/or the FC is responsible for assuring that appropriate floor loading signs are displayed and the design loading is not exceeded.

The use and marking of these signs will be in accordance with the following criteria.

- Markings are not required on concrete slab constructed directly on earth/fill.
- All floor areas will be marked in accordance with engineering design criteria as to the loads approved for the area by the Systems Engineering Competency.
- OSFA, OSEMA, will furnish the signs upon request or as a part of facilities safety and health audit.
- Areas with an allowable load of 300 psf and above will be marked with notice signs; below 300 psf will be marked with caution signs. In both cases, the signs will display the actual approved load in pounds per square foot.
- Sufficient signs will be placed in the space to which they relate so that building occupants will be aware of the loading limitations.
- All drawings and specifications involving new construction must indicate allowable floor loadings and provide for the appropriate signs.

2.7 SIGNS—INDUSTRIAL, TRAFFIC SAFETY, AND INFORMATION

The following procedures are to be used to ensure compliance with LAPD 1500.5, "Signs and Directory Boards," appropriate codes and standards, and to control location and type of signs:

- Obtain Office of Security and Public Safety (OSPS) approval for all short/urgent Work Orders and/or NASA Langley Form 69s ("LaRC Work Request") requesting traffic and/or parking lot changes. **NOTE:** Industrial and traffic safety signs are available from OSPS and OSFA, OSEMA, respectively.
- Obtain approval of the Office of Logistics Management (OLM) for all other types of signs such as facility names and reserved parking designations. **NOTE:** Signs will not be fabricated or installed without appropriate authorization by either OSEMA or OLM.

Chapter 3**3. SPECIAL SYSTEMS REQUIREMENTS****3.1 PRESSURE SYSTEMS**

NASA policy applicable to these systems is set forth in NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems." Guidelines for the application of this policy to ground based systems are contained in NPR 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," which has been accepted by the Department of Labor as "equal to or better" than OSHA standards.

3.1.1 Systems Requirements

LaRC implementation of the Agency requirements is contained in LPR 1710.40, "Safety Regulations Covering Pressurized Systems."

3.1.2 "Witnessing" Policy

Hydrostatic or pneumatic testing of pressure systems is a basic requirement of LPR 1710.40. It is required that the acceptance testing of pressure systems used on LaRC experimental equipment, or being procured for use at LaRC, be witnessed as follows:

- Pressure tests conducted elsewhere for systems to be used at LaRC are to be witnessed by a representative such as the LaRC Resident Engineer, or other selected NASA personnel.
- Testing of pressure systems (at or away from LaRC) which are not destined to become a part of an LaRC facility system should be witnessed as determined by the responsible LaRC Project Manager.

3.2 MECHANICAL SYSTEMS

LaRC Machinery Safety Policy requires, as a minimum, that new and existing machinery will be in accordance with the latest OSHA, Part 29 CFR 1910 requirements. LaRC mechanical requirements applicable to machinery are:

- Machines (manual or powered) must be properly anchored to prevent walking or moving. Specifically, any machine must be anchored that might move or walk because of unbalanced operation (tipping) or because it is located so that passing heavy equipment could impact or upset the machine. Excluded from this requirement are tools and machines explicitly designed for portable use.
- Existing machinery will be brought into compliance with OSHA standards which require the machine operator and other employees to be protected from rotating and moving parts. The LaRC annual safety and health inspection will identify those machines requiring corrective action.
- All purchase requests and contractual commitments which include machinery must contain in the specifications a requirement that guarding is in compliance

with OSHA, Part 1910, Subpart "O." All such specifications will be reviewed and approved by the Safety Manager.

3.3 ELECTRICAL SYSTEMS

The basic LaRC standard for these systems is the OSHA recognized National Electric Code (NEC). Specific LaRC policy and interpretations of the NEC are contained in LPR 1710.6, "Electrical Safety."

3.3.1 Working Clearances

LaRC has adopted the working clearances specified by the NEC, Section 110-16, entitled "Working Space About Electrical Equipment (600 Volts or Less)."

3.3.2 "Hot Stick" Safety Procedures

Due to the extremely hazardous potential of discharging high electrical storage, special requirements are specified. LaRC "Hot Stick" safety procedures for each High Voltage Test Facility are required to be written as a detailed step by step outline of how to safely deenergize capacitor banks prior to making changes or adjustments. Each facility "Hot Stick" procedure will conform to the requirements of LPR 1710.6.

3.4 WATER CONNECTIONS

Contamination of the potable water supply is prohibited. LaRC policy has established safeguards against possible contamination of the fresh water supply caused by backflow or back siphonage. These safeguards are:

- Where the possibility of a cross connection may exist, backflow prevention devices, or the equivalent, will be installed and tested periodically.
- Any suspect cross connection or suspect contamination of fresh water will immediately be reported to the FSH.

Chapter 4**4. FACILITIES AND STRUCTURES SAFETY****4.1 SCAFFOLDING**

It is LaRC policy to assure compliance with minimum safety requirements in the design, construction, erection, and use of scaffolding platforms, metal and wood; and including all varieties of fixed and mobile self-supporting, suspension, and special types of scaffolding. The basic standard applicable to these devices, when utilized by Center employees or support service contractors, is OSHA, Part 1910.28. (See OSHA, Part 1926.451 for construction industry standards.)

4.1.1 Responsibilities

It is the responsibility of OSFA to ensure that purchased, fabricated (temporary), or issuance of existing scaffolding, to be used by either LaRC or its construction contractor personnel, conform to the OSHA requirements. Additionally, OSFA will certify all newly erected staging (prefab-type scaffolding), including the type of platform to be used, as safe prior to its use.

4.1.2 Line Management

Facility Coordinators, Construction Inspectors, or designated Contracting Officer's Technical Representatives (COTR)/Contract Monitors will ensure that:

- When working from suspension-type scaffolding, each worker is protected by an approved safety harness attached to a lifeline. The lifeline must be securely attached to substantial members of the structure (not the scaffolding), or to securely rigged lines which will safely suspend the worker in case of a fall.
- Any scaffold, including accessories such as braces, trusses, screw legs, ladders, and so forth, damaged or weakened from any cause, will immediately be repaired or replaced.

These personnel are also responsible for ensuring the prompt and safe dismantling of scaffolding and staging when no longer required.

4.1.3 General Requirements

Personnel using scaffolding at LaRC must observe the following requirements:

- Scaffolds will not be erected, moved, dismantled or altered except under the supervision of authorized competent persons (OSFA, extension 47233). Furthermore, scaffolds will not be altered or moved horizontally while they are in use or occupied.
- The footing or anchorage for scaffolds will be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks must not be used to support scaffolds or planks.

- Guardrails and toeboards (minimum height of four inches) will be installed on all open sides and ends of platforms more than 10 feet above the ground. Hand rails, 2 inches by 4 inches or the equivalent, will be installed no less than 36 inches or not more than 42 inches high, with a midrail, when required, of 1 inch by 4 inch lumber or equivalent.
- Supports for guardrails and toeboards will be at intervals not to exceed eight feet.
- Scaffolds and their components will be capable of supporting, without failure, at least four times the maximum intended load. To assure that the working load is not exceeded, the maximum capacity must be displayed on a tag or plate firmly affixed to the scaffolding or staging.
- An access ladder or equivalent will be provided.
- Scaffolds must be secured to permanent structures through the use of anchor bolts or other equivalent means. Window cleaner anchor bolts will not be used.
- The use of shore scaffolds or lean-to scaffolds will be prohibited.
- Wooden scaffolding requirements also specify that:
 - ☐ Planking lumber grade, maximum permissible span, and nail or bolt requirements shall be as specified in the appropriate sections of OSHA, Parts 1910.28 and 1926.451.
 - ☐ Plankings or platforms shall be overlapped a minimum of 12 inches, secured from movement, and extended over their supports not less than six inches or more than 12 inches.
 - ☐ Poles, legs, and uprights of scaffolds shall be plumb and securely and rigidly braced to prevent swaying and displacement.
- Special considerations which must be tailored to the individual application are specified in detail in the two OSHA standards, and include:
 - ☐ Tag lines and tie-offs.
 - ☐ Overhead protection.
 - ☐ Underneath protection.
 - ☐ No work conditions.
 - ☐ Rope protection.
 - ☐ Fire prevention.
 - ☐ Uplift locks.
 - ☐ Maximum occupancy.
 - ☐ Adjacent heat sources.

4.2 HIGH WORK

LaRC policy prescribes safety requirements and procedures for assigning employees tasks that involve working at elevated levels, commonly referred to as "high work."

4.2.1 Elevated Levels

Working spaces 25 feet or more above ground level which are not enclosed by normal structural walls and ceilings are considered elevated. This definition is consistent with ANSI and OSHA, Part 1926 standards and includes substations, gantries, and

certain hazardous roofs. Not included are internal balconies and flat roofs having appropriate floor loading capacity and OSHA compatible rails, guards, parapets, and so forth. Levels less than 25 feet may be categorized as elevated if supervision determines that unusual exposure conditions so warrant.

4.2.2 Elevated Level Worker

A worker performing high work, i.e., normal or periodic duties or assignments which require that the worker function at elevated levels, is an elevated level worker.

4.2.3 Safety Requirements

Before assigning employees to work at elevated levels, supervisors will ensure that the following safety requirements and precautions are observed:

- Provide adequate safety measures, equipment and/or devices to minimize any potential hazard that could be encountered while working at the elevated levels. These devices include, but are not limited to, safety harnesses, guardrails, lifelines, and/or scaffolds.
- Instruct employees regarding working at elevated levels specific to the tasks that are to be performed. Paramount to such instruction will be the daily inspection of all safety equipment to be used. In inclement weather, only emergency operations will be permitted.
- Employees are to obtain medical examinations to ensure that they are physically qualified to perform assigned tasks at elevated levels.
- Make certain that the employee is physically capable of performing work at elevated levels each day the employee is assigned this type of task. If there is any doubt or reservation as to the employee's physical capabilities (even though the employee may have previously been medically certified to perform at elevated levels), the assignment should be deferred. Be alert to any indications of the effects of alcohol, drug consumption, or mental stress.

4.2.4 Responsibilities

Supervisors are responsible for complying with the requirements of this section. Supervisors should refer all questions relative to working at elevated levels to the Safety Manager, or the Occupational Health Officer, Office of Human Resources, for advice and guidance.

Upon receipt of a completed NASA Langley Form 66, "Worker Appointment and Certification Form," the Occupational Health Services Office (OHSO) will arrange for physical examinations of employees subject to working at elevated levels. Examinations will specifically include consideration of physical defects or conditions that could create a potential hazard while working at elevated levels (for example, vertigo, epilepsy, fainting spells, and so forth).

The OHSO is responsible for certifying, on NASA Langley Form 66, that employees examined have been found medically qualified to perform work at elevated levels.

This certification will be made prior to initiation of work and/or whenever deemed necessary.

The certifying official will be the Safety Manager, who will verify the proper completion of NASA Langley Form 66, maintain certification records, and provide authorizing documentation.

OSFA, OSEMA, will counsel supervisors regarding appropriate safety precautions and approved safety devices to be used when working at elevated levels.

4.3 ROOF WORK

LaRC roof areas are not generally designated as work areas. However, tasks such as equipment maintenance, roof repair, and various types of construction projects are occasionally performed on these surfaces. The following chapters establish the minimum safety requirements for these activities.

4.3.1 Access Control

It is the responsibility of the FC to control access to these potentially hazardous roof areas. To support the FC in this function, the following requirements are established:

- All accesses to hazardous roof areas will be identified by appropriate warning signs.
- All personnel requiring access to roof areas will notify the FC and obtain approval prior to performing any roof activity.
- Where structural integrity or permanent safety devices do not provide sufficient protection to confine the risk to the simple "high work" category (see High Work, paragraph 4.2), special security, safety equipment and/or procedures, and temporary structural requirements will be specified and conspicuously documented by the facility. The Systems Engineering Competency, in conjunction with the Safety Manager, will assist the FC in developing these specifications.
- All Center personnel will assist the FC in identifying unauthorized building interior and exterior access to roof spaces.

4.3.2 Equipment Access

Where access to roof-located equipment (for example, heating, ventilation, and air-conditioning, aircraft warning lights, pressure systems, instrumentation stations, and so forth) is required, the following apply:

- Permanent working platforms, associated walkways or ladders, and appropriate rails and guards must be provided in accordance with OSHA, Part 1910 standards.
- Those workers requiring access will be identified and certified as "high workers."
- Approved safety equipment and procedures will be used for these operations.

For buildings with adequate structural integrity, the same requirements described in paragraph 4.3.1 of this chapter apply to roof repair or modification. Roof activities on surfaces that are structurally inadequate, or which are not permanently configured for such work, have the following additional requirements (all cement-asbestos paneled roofs are automatically in this category):

- Internal building access to these roofs must be secured by locks and the keys maintained by the FC or alternate.
- Roof prime load-carrying members (or alternatively the minimum spans that guarantee load support), including allowable loads, will be identified and documented in the Facility files.
- Prior to initiation of roof repair or modification, the affected parties (NASA, contractor or subcontractor) will be briefed on both the potential hazards and recommended minimum safety considerations associated with the performance of the specific roof task. The responsibility for this coordination depends upon the personnel performing the task:

<u>Worker</u>	<u>Responsibility</u>
NASA/LaRC	Facility Safety Head/FC
Support Service Contractor	COTR and/or Technical Monitor
Construction	Assigned Inspector Contractor

4.4 CONFINED SPACES

Any space not intended for continuous employee occupancy, having a limited means of egress, and which is also subject to either the accumulation of an actual or potentially hazardous atmosphere or a potential for engulfment is considered to be a confined space. Confined spaces generally include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, manholes, underground utility vaults, acid tanks, digesters, ovens, kiers, pulpers, tunnels, furnaces, degreasers, test chambers, compartments, vats, certain locations within aircraft and spacecraft when not in flight, and pipelines. Open top spaces more than four feet in depth, such as pits, tubs, vaults, and vessels, may also be confined spaces.

It is LaRC policy, applicable to all personnel, contractors, and operations at NASA, to prevent exposure to dangerous air contamination when entering into and working within confined spaces. Dangerous air contamination is any atmosphere presenting increased risk of health impairment, injury, disablement, or death, such as:

- Combustible or flammable gases and vapors at concentrations in excess of 10 percent of their lower explosive limit.

- An oxygen concentration less than 19.5 percent or greater than 23.5 percent by volume.
- Toxic substances present at concentrations in excess of their permissible exposure limits or threshold limit values (TLVs).

NOTE: OSHA exposure standards (29 Code of Federal Regulations (CFR) 1910) will be used unless the American Conference of Governmental Industrial Hygienists (ACGIH) TLVs are more restrictive, in which case ACGIH guides will be used.

4.4.1 Responsibilities

Supervisors will have overall responsibility for entry and work in confined spaces and for ensuring that the requirements of this standard are implemented. Since the LaRC fire department is trained and equipped to conduct confined space rescue, the fire department (extension 45600) shall receive prior notification that there will be a confined space entry. Supervisors will request assistance from the LaRC Industrial Hygiene function, OSFA, OSEMA, if there is any doubt about whether a location meets the criteria of a confined space. The LaRC Industrial Hygienist (for Civil Servants) and the contractor Safety function (for contractor personnel) will:

- Evaluate and approve entry by permit and/or operating procedures.
- Review equipment to be used.
- Ensure that atmospheric measuring equipment is installed, maintained, calibrated, and used properly.
- Assist supervisors in identifying and posting areas to be considered confined spaces and in training or approving training programs for personnel entering confined spaces.
- Test the atmosphere, or as deemed appropriate, certify other personnel to perform this task.

4.4.2 Permit/Procedure System

An OSEMA Organizational Form N-1222, "Confined Space Entry Permit," or approved procedure where entry is on a routine basis and hazards are well known, will be required (see Figure 4.1, next page). Attention to detail similar to that of the Entry Permit will be required for an approved procedure. An approved procedure must be updated and reviewed at least annually.

4.4.3 Posting

Confined spaces will be posted at all times with the sign shown in Figure 4.2. During periods when work is scheduled within the confined space, a copy of the permit or procedure will also be posted.

CONFINED SPACE ENTRY PERMIT					
SECTION I - TO BE COMPLETED BY SUPERVISOR					
Permit Valid From Date _____ Time _____ to Date _____ Time _____				Location and Description of Work	
Chemicals to Be Used (describe fully)					
Previous Contents			Entry and Stand-by Personnel (Names)		
Expected Entry Date		Expected Entry Time		Outside Contractors (Name)	
Hazards Expected:(Describe) <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <input type="checkbox"/> Corrosive Materials _____ <input type="checkbox"/> Hot Equipment _____ <input type="checkbox"/> Flammable Materials _____ <input type="checkbox"/> Toxic Materials _____ <input type="checkbox"/> Inert Gases _____ </div> <div style="width: 48%;"> <input type="checkbox"/> Cleaning (Ex. Chemical or Water Lance) _____ <input type="checkbox"/> Spark-Producing Operations _____ <input type="checkbox"/> Spilled Liquids _____ <input type="checkbox"/> Other _____ </div> </div>					
Completed by (Name)					Telephone Number
SECTION II - TO BE COMPLETED BY CONFINED SPACE MONITOR					
Hazards & Other Factors To Be Evaluated (From Section I)					
SECTION III - TO BE COMPLETED BY CONFINED SPACE MONITOR OR DESIGNEE					
Initial Atmos. Tests Perf'd.		Location		Concentration	
Explosibility (LEL)					
Oxygen				Initial Tests Performed By	
Toxic Contaminant					
Dusts				Time _____ Date _____	
Other					
Atmos. Tests (Follow-Up)		Location		Concentration _____ Time _____	
Explosibility (LEL)					
Oxygen				Periodic Tests Performed By	
Toxic Contaminant					
Dusts				Date _____	
Other					
SECTION IV - TO BE COMPLETED BY SUPERVISOR AND CONFINED SPACE MONITOR					
Protection Gear		Yes	No	Type/Comment	
Respirators					
Protective Clothing					
Protective Helmets					
Eye Protection					
Foot Protection					
Life Lines & Harness					
Lighting					
Communications Equip.					
Ventilation					
Monitoring Equip.					
Remarks Training Have entry and stand-by employees received proper training? <input type="checkbox"/> Yes <input type="checkbox"/> No				Isolation Checklist <input type="checkbox"/> Blanking and/or disconnection <input type="checkbox"/> Other: _____ <input type="checkbox"/> Electrical _____ <input type="checkbox"/> Mechanical _____ <input type="checkbox"/> Tagging and Lockout _____	
Special Entry and/or Work Procedures					
CERTIFICATION I certify that all requirements of this Confined Space Entry Permit have been met.					
Signature of Supervisor		Time		Date	
				Actual Time of Entry	

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N - 1222

Figure 4.1, Confined Space Entry Permit



Figure 4.2, Confined Space Warning

4.4.4 Training

All employees required to enter confined spaces (including standby employees) will be trained regarding the nature of the hazards involved and trained in operating and rescue procedures, including the necessary precautions to be taken and the proper use of required personal protective and emergency equipment. Procedures must be thoroughly explained so that each person is aware of the proper action to take under varying circumstances. All persons must be totally familiar with the system of communication used during confined space work.

4.4.5 Atmospheric Testing

Prior to entry into a confined space, atmospheric tests will be conducted to determine the presence of dangerous air contamination. Subsequent atmospheric testing with hourly recording is required.

4.4.6 Ventilation

In all cases of dangerous air contamination, ventilation will be recommended as the primary means of control. Continuous general dilution or local exhaust ventilation will be maintained where dangerous air contamination is produced as part of a work procedure (for example, cleaning with solvents, welding, or painting), or where dangerous air contamination may develop due to the nature of the confined space (for example, desorption from walls or evaporation of residual chemicals). Ventilating a confined space does not eliminate the need for atmospheric testing.

Ventilation equipment used to prevent situations that are immediately dangerous to life and health will have an audible warning device to signal ventilation system failure.

It is good practice to ventilate all confined spaces before entry and during occupancy even though no dangerous air contamination is present.

4.4.7 Prevention of Dangerous Air Contamination

Accidental introduction of dangerous air contamination into the confined space through interconnecting equipment such as piping, ducts, vents, drains, and so forth, will be prevented by positive means such as lock-out and tagging, disconnection of pipes, blind flanges, two block valves with an open vent between them, or other procedures.

4.4.8 Electrical Equipment

Since tanks, damp manholes, and so forth, often constitute "massive electrical grounds," electrical circuits in confined spaces will be deenergized and locked out as warranted due to the potential for electrical shock. Any electrical equipment used inside confined spaces should be properly insulated and grounded. Only explosive-proof electrical equipment, in accordance with Article 500 of the NEC, and nonsparking hand tools will be used in confined spaces subject to contamination by combustible/flammable vapors, gases, or particulates. Where possible, it is desirable to use pneumatically driven power tools equipped with conductive air supply hoses. Nitrogen or other inert gas pressure will not be used as a substitute for air pressure unless specifically approved by the confined space monitor. All hand-held electrical equipment must have a ground fault interrupter circuit breaker (4 to 6 mA where possible) at the power source unless the power source is an ungrounded portable generator, an ungrounded battery source less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.

4.4.9 Personal Protective Equipment for Civil Servants

Protective equipment will be used as follows:

- Suitable goggles or full-coverage face shields with goggles, impervious outer clothing, gloves, hood, and boots must be worn, as necessary, to protect against irritating, corrosive, or toxic contaminants.
- Hard hats must be worn in confined spaces when circumstances so warrant. Hard hats must meet the requirements specified in 29 CFR 1910.135.
- Depending on the extent of the hazard, lifelines and safety harnesses may also be required. Safety harnesses will be certified according to Section 4 of ANSI A10.14-1975. Lifelines may not be less than 1/2-inch nylon (5/8-inch preferred) or 3/4-inch manila rope of good quality without splices. Lines must be inspected periodically to ensure that they are free from defects. A line will be securely attached to the harness, and the free end of the line should be secured outside the entry opening, checked prior to entry, and not be removed while inside the confined space. The safety harness will be of the type that permits easy rescue of persons from the confined space during emergency

conditions. In cases where the size of the entry/exit opening is less than 19 inches, a wrist-type harness will be used. Where possible, a hoisting device or other effective means can be provided for lifting personnel out of the confined space.

- Respiratory protection needs for civil servants will be determined by LaRC Industrial Hygiene personnel (OSFA, OSEMA), based upon conditions and test results of the confined space and the work activity to be performed. Respirators will be NASA/National Institute of Safety and Health (NIOSH)-approved devices and will be fitted, used, and maintained in accordance with OSHA respiratory protection, air contaminant, and other applicable standards. The quality of air used in supplied-air respirators will meet OSHA requirements (Compressed Gas Association Grade D). Annual physical examinations to determine ability to use respiratory protective devices and perform the work that may be required shall be administered to all personnel who work in confined spaces, including standby personnel. Only when ventilation has been found to be impractical or ineffective will personal respiratory protective equipment be required as a primary means of control.

4.4.10 Standby Personnel

Standby personnel will be positioned outside confined spaces to give assistance in cases of emergency. Standby personnel will have no assigned duties to perform other than to observe and communicate with persons inside the confined space. Audible voice, radio/telephone, constant visual, or other suitable forms of communication between the persons in confined spaces and standby personnel will be continuously maintained. The system will be tested immediately upon entry to confirm its effectiveness. Also, standby personnel will have a communication link with additional persons who can render help in emergencies. The LaRC fire department is trained and equipped for confined space rescue and, should rescue become necessary, they shall be called on extension 911.

4.5 ASBESTOS

Asbestos is a generic term for a number of naturally occurring, hydrated mineral silicates, incombustible in air and separable into filaments, such as chrysotile, amosite, crocidolite, and other forms as described by OSHA.

It is LaRC policy to prevent exposing personnel or the environment to friable asbestos in accordance with Federal, State, and local regulations applicable to asbestos. This applies to all personnel and operations at LaRC, including contractors. Present Commonwealth of Virginia regulations exempt Federal facilities from having a Project Monitor on site for asbestos abatement projects unless the abatement is greater than or equal to 1600 square feet or 2500 linear feet. According to 40 CFR 763, Subpart E, Appendix C6, Project Monitors observe abatement activities performed by contractors and generally serve as a building owner's representative to ensure that abatement work is completed according to specifications and in compliance with all relevant statutes and regulations. It is a conflict of interest under present Commonwealth of Virginia regulations for a contractor to have an employee/employer relationship with or

a financial interest in asbestos monitoring work performed by a Project Monitor. Regulations also require that an asbestos contractor shall not have any financial interests in the firm of which the Project Monitor is an employee. This section in no way relieves the abatement contractor of the OSHA requirements for personnel monitoring requirements.

In the past, OSEMA has provided all project monitoring services for asbestos abatement jobs performed by the Facilities Engineering Support Services (FESS) Contractor removal team. For all future projects, the following information applies:

- OSEMA will provide Project Monitors and personnel sampling for all asbestos work being performed at LaRC that is ≤ 10 square feet or 10 linear feet. This information is taken to ensure Government employees' protection and will be provided to the FESS Contractor for informational purposes only. This support in no way relieves the abatement contractor of the OSHA requirements or personnel monitoring requirements.
- OSEMA will monitor all glove bag removal operations and small containment jobs (≤ 10 square feet or 10 linear feet) at no additional cost. Additionally, OSEMA will spot check areas exterior to the containment area and at the clearance inspection to protect civil service employees adjacent to the regulated areas.
- Personnel monitoring of all other jobs (≤ 10 square feet or 10 linear feet) will be the responsibility of the asbestos abatement contractor only.
- The FESS Contractor will assume responsibility for personnel monitoring of its employees for regulatory compliance as required by Federal Law (OSHA 29 CFR 1926.1101) on all jobs ≥ 10 square feet or 10 linear feet.
- LaRC Work Control will need to notify the FESS Contractor and OSEMA in advance of any asbestos removal work requiring a 20 day notification to the Commonwealth of Virginia. A 20 day notification is required on all work that involves removal of more than 10 linear feet or 10 square feet of asbestos containing material (ACM). Additionally, notification to OSEMA shall include the total amount of ACM to be removed and anticipated start dates for monitoring and for clearance sampling to be conducted.

Operational considerations for asbestos-related activities are as follows:

- Prior to any operation involving removal, repair, or any other procedure which may result in release of airborne asbestos, an inspection will be conducted to evaluate the potential hazard and to recommend appropriate controls.
- The inspection team will consist of the LaRC Industrial Hygienist, the contractor safety official, the contractor operational supervisor ("competent person" as defined by OSHA regulations), and a facility representative, either the FSH or FC. The inspection team will establish operational and control procedures which are documented through issuance of OSEMA Organizational Form N-1506, "Asbestos Safety Permit " (see Figure 4.3).

ASBESTOS SAFETY PERMIT			
JOB DESCRIPTION AND LOCATION			CURRENT DATE
			START DATE
			ESTIMATED JOB
DURATION			
ASBESTOS WORKER'S NAME	LICENSE NUMBER	ASBESTOS WORKER'S NAME	LICENSE NUMBER
SAMPLE			
CONTROLS			
<input type="checkbox"/> TYVEK COVERALLS <input type="checkbox"/> RESPIRATOR (TYPE) <input type="checkbox"/> HEPA VACUUM <input type="checkbox"/> OTHER _____ <input type="checkbox"/> GLOVES <input type="checkbox"/> AREA CONTROLS/ENCLOSURE <input type="checkbox"/> NEGATIVE AIR <input type="checkbox"/> GLOVE BAG <input type="checkbox"/> WET METHOD <input type="checkbox"/> SHOWER			
MONITORING REQUIREMENTS			
<input type="checkbox"/> AREA MONITORING <input type="checkbox"/> PERSONAL MONITORING DURING REMOVAL			
NOTIFICATION REQUIREMENTS			
<input type="checkbox"/> COMMONWEALTH OF VIRGINIA <input type="checkbox"/> U. S. ENVIRONMENTAL PROTECTION AGENCY			
APPROVALS			
CONTRACTOR SAFETY OFFICER (SIGNATURE)		LICENSE NUMBER	DATE
CONTRACTOR INSULATION SUPERVISOR (SIGNATURE)		LICENSE NUMBER	DATE
COGNIZANT OFFICIALS			
LaRC SAFETY MANAGER (SIGNATURE)			DATE
FACILITY REPRESENTATIVE (SIGNATURE)			DATE

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Prescribing Document LPR 1740.2
PREVIOUS EDITIONS OBSOLETE

OSEMA N-1506

Figure 4.3, Asbestos Safety Permit

- Applicable portions of 29 CFR 1926.1101, "Asbestos," will be incorporated as appropriate into all asbestos operations.
- Asbestos Configuration Management reporting will be coordinated in accordance with LPR 1740.4, "Facility Systems Safety Analysis and Configuration Management," Chapter 8.
- Asbestos materials will be disposed of in accordance with Federal, State, and local rules and regulations. Implementation will be the contractor's responsibility in coordination with the Office of Environmental Engineering (OEE), OSEMA.
- Asbestos removal operations shall be conducted in accordance with LPR 8800.1, "Environmental Program Manual," Chapter 9, "Asbestos."
- Replacement insulation will be asbestos-free and identified with stickers which say "**Non-Asbestos**" or "**Asbestos Free.**"

4.6 SECURITY (SECURE) AREAS

Design, operational, and emergency access safety requirements for secure areas are presented in this section.

4.6.1 Design Safety

All requests for "security areas" which require facility modification will generally be accomplished by submitting NASA Langley Form 69, "LaRC Work Request," with a sketch or drawing, to the Zone Maintenance Manager. The security and safety representatives will physically review and approve the requested areas to ensure compliance with security and life safety regulations. Specific security hardware, hardware locations, facility access/egress routes, and so forth, will be annotated on the sketch/drawing and signed by the FSH. The approval document (copy) is to be posted at the entrance with the authorized entry personnel roster.

For areas where modification is not required, the OSFA, OSEMA, must be informed by the requester and/or the Office of Security and Public Safety (OSPS), OSEMA, so that a safety review can be performed. (See LAPD 7000.2, "Review Program for Langley Research Center (LARC) Facility Projects.")

4.6.2 Operational Safety

The FSH will post at the main entrance door(s) a roster of two or more persons who can be contacted for after duty hours entry. If the FSH is not on the approved access list, an organizational FSH will be appointed to exercise safety responsibilities within the security area. All security area operations require that the buddy system be used.

During the annual facility safety and health audit, the safety specialist responsible for the facility will review "security areas" for safety policy compliance. Appropriate access authorization will be obtained through security channels by the safety personnel involved.

4.6.3 Emergency Access

Facility personnel must be aware that in the event of a mishap, safety personnel will have access to the security area after showing their badges and identifying themselves. OSPA has a list of safety personnel for cross reference and identification.

4.6.3.1 Health/Injury Emergency

- CoH medical personnel will respond.
- Medical personnel will obtain immediate entry to the area (forced entry if access doors cannot be immediately unlocked).
- OSPA will respond to the request and, after response activities are complete, debrief all involved parties who gained access.
- After affected personnel obtain medical treatment, the employee will report the incident in accordance with LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."

4.6.3.2 Fire Alarm

The Fire Department will respond to a fire alarm as follows:

- Obtain immediate entry (forcing doors if doors are not immediately unlocked).
- Locate and extinguish the fire.
- After the fire is extinguished, relinquish control of the area to OSPA, who will debrief all response personnel when the emergency response is completed .

4.7 PROBLEM/FAILURE REPORTS (PFR)

Although the Center-wide PFR system has been shut down, facilities are encouraged to report problems/failures through the computerized maintenance management system with OSEMA being informed of the problem/failure.

Chapter 5

5. MECHANICAL EQUIPMENT ROOMS

5.1 HOUSEKEEPING

All LaRC mechanical equipment (M.E.) rooms will be kept clean and clear of excessive combustible materials.

5.2 ELEVATOR M.E. ROOM ACCESS

Access doors for LaRC elevator M.E. rooms must meet the requirements of ANSI A17.1, latest revision. This requires doors to be self-closing with a spring-type lock arranged to permit the doors to be opened from inside without a key. Doors are to be kept closed and locked except during periods when an attendant is on duty in the room.

Chapter 6**6. EQUIPMENT SAFETY****6.1 FORKLIFT TRUCKS**

LaRC forklift practices, procedures, and requirements are consistent with OSHA, Section 29 CFR 1910.178. LaRC forklift equipment and operational requirements are stated below.

6.1.1 New Equipment Requirements

All new powered industrial forklifts acquired and used by LaRC will meet the design and construction requirements established in the latest revision of ANSI B56.1, except for vehicles intended primarily for earth moving and over the road hauling.

The user will ensure that all capacity, operation, and maintenance instruction plates, nameplates, required decals, and markings are in place and maintained in a legible condition.

6.1.2 Overhead Guards

Safeguards which protect the operator from physical injury are required on all new or existing forklifts.

High lift forklifts will be fitted with an overhead guard manufactured in accordance with the latest revision of ANSI B56.1. Where operating conditions do not permit use of this guard, approval for noncompliance must be obtained from the Safety Manager.

An overhead guard will be used as protection against falling objects. An overhead guard is intended for protection from the impact of small items such as packages, boxes, bagged material, and so forth. It is not intended to withstand the impact of a falling capacity load.

If the type of load presents a hazard, the user will equip forklifts with a vertical load backrest extension manufactured in accordance with the latest revision of ANSI B56.1.

6.1.3 Personnel Safeguards

Forklift operators must be certified (see LPR 1740.6, "Personnel Safety Certification"). Whenever a forklift is used for lifting personnel, the following additional precautions will be taken (see LPR 1740.6, "Personnel Safety Certification"):

- Only trained and authorized operators will be permitted to operate the forklift.
- The platform shall be certified for personnel use and firmly secured to the lifting carriage and/or forks.
- Falling object protection will be provided when warranted.

6.1.4 Safe Loads and Loading Practices

Handle only stable or safely arranged loads and do not exceed the rated capacity of the forklift.

Modifications to increase a forklift's load capacity are permitted only when approved by the forklift manufacturer.

6.1.5 Vehicle Maintenance

Forklifts covered by these requirements will have their load life capability verified every five years and as required due to major repair. The rated load will be centered on the lifting forks during the load test with the test being conducted in accordance with ANSI B 56.1, as amended. The date of the next load test will be stenciled on the right vertical boom. Load tests are the responsibility of the Systems Engineering Competency, through the Center maintenance contractor.

Normal vehicle maintenance and roadworthiness remains the responsibility of the Transportation and Motor Vehicle Operations Officer (TMVOO). (See LAPD 6000.3, "Motor Vehicle Management.")

6.1.6 Lifting Devices and Equipment

Criteria provided within this section apply to LaRC owned equipment and LaRC contractor owned and/or leased equipment operated at LaRC. The application and use of this equipment is divided into three categories:

- Mission Essential Program Lifting Hardware.
- General Research Operations.
- Full Time Rigging Operations.

6.1.7 Mission Essential Program Lifting Hardware

LaRC mission essential program lifting hardware will be subjected to special design analysis and documentation as required by the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO 1740.9. This review and analysis will be coordinated by the Safety Manager. Application of the safety standard requirements will be dependent on the lifting operation type, associated risk, additional operator training, and documented safety rationale for the operations and enforcement of established policy.

6.1.8 General Research and Rigging Operations

LaRC general research and rigging operations will be controlled by the criteria provided herein which meets the intent of NSS/GO 1740.9. Variances, when requested, will be submitted to the Safety Manager, for a review and analysis similar to that done for mission essential program lifting, before forwarding for Director, OSEMA, approval.

Certification of personnel to perform lifting operations at LaRC will be in accordance with LPR 1740.6, "Personnel Safety Certification."

6.1.9 Cranes and Hoists

The maintenance of cranes and hoists is the responsibility of the Systems Engineering Competency (SEC) through the Center maintenance contractor and will be accomplished in accordance with applicable ANSI standards (ANSI B30.11, ANSI B30.2). Operational considerations for cranes and hoists are as follows:

- Overhead cranes will be equipped with emergency disconnect switches located in the immediate vicinity of the crane operation. Each cut off switch will be plainly identified and personnel operating the crane will know the exact location of the switch. Pneumatic cranes will have their cut-off valves identified and located in the same manner.
- Only authorized personnel instructed in the safe operation of cranes and hoists will be permitted to operate such equipment (LPR 1740.6).
- Cranes and hoists will receive inspection and load testing in accordance with Tables 6.1 and 6.2 (next two pages), as a minimum.
- The LaRC computerized maintenance program will serve as the auditable documentation to track maintenance effectiveness. Each item, as a minimum, will be identified and show last test and due test dates. All permanent maintenance records will be maintained by the SEC .

6.1.10 Cab-Operated Overhead Cranes

Operational considerations for cab-operated overhead cranes are as follows:

- The general arrangement of the cab and the location of the control and protective equipment should be so that all operating handles are within convenient reach of the operator. Cab construction will be in compliance with ANSI B30.2.
- Access to the cab or bridge walkway will be by a fixed ladder, stairs, or a platform. No step-over gap will exceed 12 inches.
- A suitable fire extinguisher and cab lighting will be provided for safe operation.
- There will be a means of emergency egress from the cab.
- All electrical switches, resistors, runway conductors, and lamps must meet the design requirements of ANSI B30.2.
- All hoisting equipment, equalizers, and hooks must meet the requirements of ANSI B30.2.
- All cab operated cranes equipped with a power traveling mechanism will be equipped with an audible warning device.
- These cranes may be modified only if such modifications and the supporting structure are analyzed by either a qualified person or the crane manufacturer. A crane whose load supporting components have been modified will be tested and the new rated load will be displayed in accordance with ANSI B30.2, as amended.
- All crane welding and materials will comply with ANSI B30.2, as amended.

TABLE 6.1
TESTS AND INSPECTION FREQUENCY

<u>Equipment</u>	<u>Frequency Inspection</u>	<u>Minimum Periodic Inspection</u>	<u>Rated Load</u>	<u>Proof Load</u>
Cranes, Overhead, All Types	Daily/Each Use	Annual	5 Years	First Use
Cab Operated Overhead Cranes	Daily/Each Use	Annual	5 Years	First Use
A Frame	Daily/Each Use	Annual	5 Years	First Use
Winches	Daily/Each Use	N/A	5 Years	First Use
Shop Lifts	Daily/Each Use	N/A	5 Years	First Use
Special Harnesses and Bars	Daily/Each Use	Annual	5 Years	First Use
Slings	Daily/Each Use	Annual	N/A	First Use
Come-A-Longs, Chain Falls	Daily/Each Use	Annual	5 Years	First Use
Associated Hardware	Daily/Each Use	Annual		First Use
Mobile Cranes/Bucket Trucks	Daily/Each Use	Annual	5 Years	First Use
Vehicle Mounted Elevating and Rotating Work Platforms	Daily/Each Use	Annual	5 Years	First Use
Self Propelled Elevating Work Platform	Daily/Each Use	Annual	5 Years	First Use
Hydraulic Jacks, All Types 1910.244	Daily/Each Use	Annual	5 Years	First Use

TABLE 6.2**PROOF LOAD TEST FACTORS, LIFTING DEVICES AND EQUIPMENT**

<u>Equipment</u>	<u>Proof Load Test Factor</u>
Cranes, Overhead, All Types	1.25
Cab Operated Overhead Cranes	1.25
A Frame	1.10
Winches	1.25
Shop Lifts	1.25
Special Harnesses and Bars	1.25
Slings	1.25
Come-A-Longs, Chain Falls	1.25
Associated Hardware	1.25
Mobile Cranes/Bucket Trucks	1.10
Vehicle Mounted Elevating and Rotating Work Platforms	1.10
Self Propelled Elevating Work Platform	1.10
Hydraulic Jacks, All Types	1.10
1910.244	

- Operator qualifications and conduct are critical. All operators will meet the training requirements of LPR 1740.6.
- Only qualified operators will enter a crane cab or pulpit with the exception of persons such as oilers and supervisors, whose duties require them to do so. Operators will assure these persons are aware of emergency egress and fire extinguisher equipment.
- A mandatory and auditable maintenance program will be implemented using Tables 6.1 and 6.2, as a minimum, for inspection and load testing frequency.

6.1.11 "A" Frames

Operational considerations for "A" Frames are as follows:

- Commercial purchase of units will be approved in advance by the Systems Engineering Competency (SEC).
- Designs for all "A" frames to be fabricated or modified will be reviewed and approved by:
 - Safety Manager, OSFA, OSEMA.
- All such devices put in service must be load tested and included in the LaRC computerized maintenance program.
- All "A" frames will be inspected and tested as shown in Tables 6.1 and 6.2. Any unit showing signs of damage or excessive wear must be removed from service.
- Height to base ratio must be less than 2.5 to 1 to prevent a tipping hazard.

6.1.12 Winches (All Types)

Winches may be powered by hand or by pneumatics, hydraulics, electricity, or motor vehicle engine power. Operational considerations for all winches which are used to lift and/or pull loads, including those mounted on vehicles, research apparatus, and inside or outside of facilities, follow:

- Purchase of all units will be approved in advance by the SEC.
- Modifications to winches are subject to the same review as for "A" frames.
- Inspection and load testing will be performed in accordance with Tables 6.1 and 6.2 and controlled by the LaRC computerized maintenance program.
- Winches used for pulling loads will be initially pull tested to their proof load. Special attention will be given to shear pin design and installation.
- Winches shall be an industrial design.

6.1.13 Shop Lifts (Manual and Powered)

Operational considerations for shop lifts are as follows:

- All shop lifts will be inspected daily and/or prior to each use.
- Shop lifts will be maintained according to manufacturer's recommendations.
- Inspection and proof testing will be accomplished in accordance with requirements of Tables 6.1 and 6.2.

- The LaRC computerized maintenance program will serve as the auditable documentation to verify maintenance effectiveness. All shop lifts will display the date of the next required load test.

6.1.14 Slings and Associated Lifting Hardware

This criteria applies to LaRC owned and/or leased slings and associated lifting hardware in service at LaRC. These devices include, but are not limited to, slings, chain falls, come-a-longs, special harnesses, spreader bars, and associated hardware and their use can be divided into three categories:

- General Facilities Operations.
- Full Time Rigging Operations.
- Mission Essential Program Hardware.

These devices and hardware will be procured to applicable OSHA, ANSI, and LaRC standards. Procurements shall include test documentation, lot sampling, and special certification, as applicable. In addition, devices used for mission essential program lifts shall meet the requirements of NSS/GO 1740.9 "Safety Standard for Lifting Devices and Equipment."

All lifting operators using these devices will meet the training requirements of LPR 1740.6 and, when applicable, NSS/GO -1740.9.

6.1.14.1 Special Lifting Harness

Special lifting harnesses, due to their application, may be fabricated in-house and/or procured commercially to ANSI and LaRC standards. Tests and inspections will be performed as shown in Tables 6.1 and 6.2.

These items will be incorporated into the LaRC computerized maintenance program. They will be identified and show last test and due test dates.

6.1.14.2 Slings, Chain Falls, Come A Longs, and Spreader Bars

Certification and control requirements for slings and spreader bars are based on ANSI B30 recommendations. All new and existing slings require testing and certification before use. The Systems Engineering Competency has established a control system for all procurement, documentation, testing, certification, and technical data for new or existing slings and lifting devices. Support contractors working at LaRC will have an equivalent program. Inspection and testing will be performed as shown in Tables 6.1 and 6.2.

Equipment defined herein is required to meet testing and certification requirements as defined in Tables 6.1 and 6.2.

6.1.14.3 Lifting Hardware

Operational considerations for lifting hardware are as follows:

- Hardware used in lifting systems includes, but is not limited to, shackles, eye bolts, and so forth.
- This equipment will be procured to ANSI, LaRC, and industrial standards.
- All associated hardware will be inspected as shown in Tables 6.1 and 6.2.
- All hardware will be stored with facility slings to prevent misuse and damage
- Any associated lifting equipment used in support of mission essential operations will be identified and maintained as determined during the formal review and analysis process.

6.1.15 Hooks (Hoisting and Miscellaneous)

Operational considerations for hooks are as follows:

- Hooks will pass the load tests of the equipment of which they are a part. Written, dated, and signed inspection reports, and documentation provided by the LaRC computerized maintenance program for lifting devices will include hooks. Inadequacies will be documented and, if determined to be a hazard, corrected prior to further use.
- Hook inspections will be governed by the inspection requirements for the equipment of which they are a part. Maintenance criteria for hoisting hooks is contained in ANSI B30.10.
- Inspection and maintenance criteria for grab hooks, foundry hooks, and choker hooks are contained in ANSI B30.10.

6.1.16 Mobile Cranes/ Bucket Trucks

Operational considerations for mobile cranes/bucket trucks are as follows:

- All mobile cranes (hydraulic, crawler, and truck types) will be procured, operated, and maintained as required in ANSI B30.5 and B30.15. Operators must meet certification requirements of LPR 1740.6.
- Load ratings, stability factors, hoist capability, control forces, and all safety factors will comply with the manufacturer's specifications. The manufacturer will, as a minimum, attach a durable label on the crane certifying that the crane meets applicable design, construction, and testing prescribed in the appropriate ANSI standard. The serial number and manufacturer's name will also appear on this label.
- The manufacturer will supply an operation and maintenance manual. The LaRC TMVOO will ensure that an effective and comprehensive inspection, testing, and maintenance roadworthiness program is maintained based on the manufacturer's recommendations and ANSI standards.

- Inspection records will be written, dated, and signed monthly on all critical items, that is, brakes, crane hooks, ropes, hydraulic cylinders, and relief valves. Hydraulic relief valve pressures will be checked semiannually and records maintained.
- The Systems Engineering Competency (SEC) will ensure that an effective inspection, testing, and maintenance program is implemented to ensure lifting certification for each special purpose vehicle as required by subject ANSI standards. Inspection and load testing will use Tables 6.1 and 6.2 as minimum criteria.
- Annual certification certificates will be in the cabs of all mobile cranes.
- Operational load tests will be conducted on new and/or extensively repaired cranes (load test not to exceed 110 percent). The next load test due date will be displayed on the right side of the boom.
- Cranes will be operated only by trained personnel as defined in LPR 1740.6 and ANSI B30.15. Medical requirements for operators will be subject to LaRC Safety Manager audit.

6.1.17 Vehicle-Mounted Elevating and Rotating Work Platforms (ANSI(A92.2) and Self-Propelled Elevating Work Platforms (ANSI A92.6))

Operational considerations for vehicle-mounted elevating and rotating work platforms and self-propelled elevating work platforms are as follows:

- Vehicle specifications, configuration, ground stability characteristics, and operating data will be included on plates permanently attached to the vehicle.
- All insulated units will clearly state in the manufacturer's manual the rated line voltage for which the aerial device was designed and tested. Identification plates attached to such units will have this certification provided.
- All design safety factors as noted in the subject standards will be maintained throughout the lift time of the work platform.
- The TMVOO will ensure implementation of a maintenance program for roadworthiness, to include standardized inspection forms peculiar to that equipment.
- The maintenance frequencies, depth of maintenance detail, and electrical test criteria will meet the manufacturer's recommendations, as a minimum.
- The SEC will ensure that an effective inspection, testing, and maintenance program is maintained for certification of each special purpose vehicle, as required by the subject ANSI standards. Tables 6.1 and 6.2 will be used as a minimum criteria for inspection and load testing.
- The operator will inspect the vehicle daily before use.
- See LPR 1740.6 for personnel safety certification requirements.

6.1.18 Auditing for Compliance

Lifting Equipment auditing responsibilities are as follows:

- The Safety Manager or representative will audit all lifting equipment programs for compliance.
- The TMVOO is responsible for the roadworthiness and vehicle maintenance of mobile lifting equipment.
- The Systems Engineering Competency is responsible for maintaining the lift integrity of lifting equipment and devices Center wide.
- The lifting operator is responsible for the daily equipment inspection to assure safe operation. This includes operator certification update as necessary.

6.2 LADDERS

LaRC ladder policy requires, as a minimum, that ladders (both metal and wood) conform to the specifications outlined in ANSI A14.1 and A14.2. Only ladders meeting these standards may be purchased or used at LaRC.

6.2.1 Procurement and Selection

Ladders are categorized as follows:

- Type IA - Extra Heavy Duty.
- Type I - Heavy Duty.
- Type II - Medium Duty.
- Type III - Light Duty (Household).

Purchase requests for ladders must specify the appropriate ANSI code and type. The Type III ladder listed above is not acceptable for use at LaRC.

6.2.2 Care and Maintenance

Ladders must be maintained in good usable condition at all times. Hardware fittings and accessories should be checked frequently and kept in good working order. Additionally, ladders should be inspected frequently for general stability and worthiness, and those found to be defective or unsafe will be immediately withdrawn from service and destroyed. Ladders will be stored in places which will afford protection and where they will not be hazards when not in use.

6.2.3 Fixed or Permanently Installed Ladders

Fixed ladders will be designed, constructed, and installed to conform with ANSI A14.3, and OSHA, Part 1910.27.

The following considerations apply to rungs and cleats:

- The distance between rungs, cleats, and steps will not exceed 12 inches, will be uniform throughout the length of the ladder, and will be free of sharp edges, burrs, or projections which may be a hazard.
- All metal rungs will have a minimum diameter of 3/4 inch. The minimum clear length of rungs and cleats will be 16 inches.
- The rungs of an individual rung ladder will be designed so that the foot cannot slide off the end.
- Rails to top landings will extend a distance of at least 42 inches above the landing. Rungs above the landing will be omitted when it is necessary to pass through the rails. Landing platforms will be provided where a person must step a distance greater than 14 inches from ladder to roof, tank, or so forth.
- Metal cages extending from a point 7 feet above the base to the top should be provided for all permanently fixed ladders 20 feet or more in height.
- The distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder will be not less than seven inches.
- It is required that a clear area be maintained at the base of any fixed ladder which is 18 inches from the centerline of the ladder along the wall and 36 inches from the rungs on the climbing side. This area should be marked on the floor to assist in keeping the area clear of obstructions.

6.3 BATTERY PROCESSING

LaRC requirements and policies for battery rooms and battery installations are in conformance with OSHA, Part 1910.178G and NEC Article 480. Each FSH and FC is responsible for assuring that each battery installation is in compliance with the requirements. Additional requirements for electrical personnel can be found in LPR 1710.6, "Electrical Safety."

6.3.1 Battery Charging

Battery charging installations will be located in areas designated for that purpose. Special requirements for these areas include:

- Facilities will be provided for flushing and neutralizing spilled electrolyte, for fire protection, and for adequate ventilation for dispersal of fumes from gassing batteries.
- When racks are used for support of batteries, they should be made of or be coated with materials not conducive to spark generation.
- When charging batteries, acid will be poured into water; never water poured into acid. Additionally, the battery vent caps should be kept in place to avoid electrolyte spray. Care should be taken to assure that vent caps are functioning. The battery (or compartment) cover(s) will be open to dissipate heat.
- Smoking will be prohibited in the charging area.
- Precautions will be taken to prevent open flames, sparks, or electric arcs in battery charging areas. Further, tools and other metallic objects will be kept away from the top of uncovered batteries.

NOTE: Storage batteries (wet type secondary cell) may be either acid or alkali type; both types produce hydrogen during charge or discharge period.

6.3.2 Battery Rooms

In addition to the above requirements, LaRC interprets OSHA requirements as follows:

- Adequate ventilation means not only to remove the corrosive fumes but to prevent the buildup of explosive mixtures of hydrogen and oxygen during periods of charging and discharging.
- Smoking and open flames are prohibited in battery rooms, battery installation areas, and battery charging areas.

LaRC requires that all charging devices or loads be removed from the batteries in a battery room, battery installation, or battery charging area before the batteries are either connected or disconnected.

LaRC requirements for battery room personnel protection are:

- Battery maintenance will be restricted to trained personnel.
- Face shield, apron, and gloves will be the minimum required personnel protection to be worn by battery maintenance personnel. (See LPR 1710.4, "Personnel Protection - Clothing and Equipment.")
- Battery rooms will also be equipped with appropriate eyewash capability as prescribed in ANSI Z358.1-1990 (the use of eyewash bottles with limited shelf life is prohibited).

6.4 KIRK KEY CONTROL

The following controls have been established to assure safe operations where duplicate Kirk keys exist:

- Duplicate keys are to be kept under lock and key and color coded red for field identification.
- Duplicate keys will be issued by the responsible FSH, or alternate, to the Facility Coordinator, or alternate.
- Issuance logs are to be maintained and an FSH approved procedure developed for key usage. An information copy of the procedure and date of key issuance should be given to the LaRC Safety Manager, Mail Stop 429.
- All duplicate keys must be logged in before initiation of research operations. If a duplicate key is issued because of a broken primary key, it is no longer considered a duplicate key and it should be included in the log.

6.5 PRESSURIZED LAMPS

Pressurized lamps in use at LaRC include mercury, high pressure sodium, metal halide, and short arc. To ensure that safe handling and disposal requirements are met, LaRC policy is outlined below:

- Potential personnel exposure to excessive ultraviolet radiation levels is possible when the lamp's outer globe is broken or punctured and lamp operation is continued.
- Extreme care should be exercised when handling pressurized lamps, especially short arc types, as the lamps can present an explosion hazard if not handled properly. These short arc type lamps are not used extensively at LaRC except in solar simulator applications.
- Special gloves and face shields are required for handling pressurized lamps, especially short arc lamps.

Manufacturer's instructions for the handling and use of pressurized lamps will be strictly adhered to at LaRC. Disposal information concerning pressurized lamps is available from the Office of Environmental Engineering, extension 43500.

6.6 GENERAL VEHICLE SAFETY (SEAT BELTS)

The purpose of this safety standard is to reduce the number and severity of motor vehicle injuries and accidents. All drivers and passengers using U.S. Government registered motor vehicles for official NASA travel are required to use available lap and shoulder safety belts whenever their use is possible, reasonable, and safe.

It is a violation of this safety standard to remove, disable, or physically circumvent the proper use of presently installed lap and shoulder safety belts.

EXCEPTIONS: This safety standard is not applicable to NASA and contract drivers and passengers if:

- The motor vehicle is not equipped with lap and shoulder safety belts.
- The driver frequently stops and leaves the vehicle, or delivers property from the vehicle, and the speed of the vehicle between stops does not exceed 15 miles per hour.
- The driver or passenger possesses a written indication from a physician that he/she is unable for medical or physical reasons to wear a lap or shoulder safety belt.
- The driver possesses a certificate or license endorsement issued by a state motor vehicle department, or a similar agency in another state or country, indicating he/she is unable for medical, physical, or other valid reasons to wear a lap or shoulder safety belt.
- The use of the shoulder belt would interfere with operation of research vehicles or those modified to support research operations.

Chapter 7**7. MATERIALS SAFETY****7.1 PYROTECHNICS AND EXPLOSIVES OPERATIONS**

LaRC policy requires that all pyrotechnic and explosive material, including residual quantities, be controlled throughout the procurement, storage, and usage stages. Research, design verification testing, and operations involving pyrotechnic devices must be coordinated with the FSH (see LAPD 1700.2, "Safety Assignments"; the Pyrotechnic Support Engineer [PSE]; and LAPD1150.2, "Boards, Panels, Committees, Councils, and Teams," The Executive Safety Board).

7.1.1 A Guide and Checklist of the Key Items to be Observed

LPR 1710.7, "Use and Handling of Explosives and Pyrotechnics," and LPR 1710.12, "Potentially Hazardous Materials," contain criteria for day to day operations. All design and research operations employing pyrotechnics or quantities of hazardous materials require special approval of the PSE and the Safety Manager.

Only authorized or certified personnel may ship, receive, withdraw, or otherwise utilize pyrotechnics at LaRC. Acquisition and disposal of pyrotechnics are controlled by using the LaRC Safety Permit process and NASA Langley Form 44, "Hazardous Material Procurement, Inventory, and Storage Record."

Off Center shipment of explosives and hazardous materials is the responsibility of the LaRC Transportation Officer in the Office of Logistics Management. Shipments are governed by Department of Transportation (DOT) regulations.

Drivers of vehicles transporting explosive materials are required to have a commercial driver's license.

Chapter 8**8. GENERAL SAFETY****8.1 DISABLED PERSONS**

To be in compliance with the Americans with Disabilities Act, designs of new facilities and modifications to existing facilities shall include considerations for the safety, accessibility, and convenience of disabled persons.

8.2 SANITATION FACILITIES

LaRC design personnel are responsible for reviewing all plumbing installation (including lavatories, showers, fountains, and toilets) for compliance with OSHA, Part 1910.141, ANSI requirements, and local codes.

8.3 OFFICE SAFETY

LaRC office safety is a very important objective, particularly since safety data indicates that a significant number of injuries occur in the office environment. Some of the causes of office injuries, treated in detail in the following paragraphs, follow:

- Lack of familiarity with office equipment and procedures.
- Shortcutting established procedures, for example, failing to call for trained and experienced movers to move office furniture or materials.
- Needless hurry which causes falls or slipping on walkway surfaces, stairs, and steps; striking against objects such as doors, desks, file cabinets, open drawers, and other people; and from improper use of chairs to gain elevation for high reaching.
- Improperly installed office furniture which may fall or overturn and strike a worker.

8.3.1 Guidelines for Office Safety

Office safety instructions follow (the FC should be contacted to correct any hazardous conditions found):

- File cabinets and storage cabinets will be bolted together or fastened to the wall or floor if their loading, location, or style represents a tipping hazard.
- Bookcase units will not be stacked higher than four units without additional safeguards.
- All new stairways, aisles, and exits must comply with NFPA Standards 101, Life Safety Code, and OSHA requirements. Existing units will conform with the intent of these requirements by using operational constraints.
- File drawers will not open into aisles unless sufficient space for a free and unobstructed aisleway remains with the drawer open.
- Telephone or electric cords are not permitted on the floor in the chair area or in walkways around desks.

- Self adhesive rubber ramps, which serve to cover or permit walking over telephone or electric cords, will not be used at LaRC in walkways or access paths. When electric or telephone service is needed in the center of an office area, overhead service and power poles from ceiling to floor will be installed beside the desk or table.

8.3.2 Maintenance of Furniture

Office furniture will be kept in good condition. Furniture in need of repair will be removed from service for repair or replacement.

In general, glass tops will not be used on desks and furniture. Where currently in use, these tops can be retained until deterioration is evident (cracks, burred edges, and so forth), at which point they will be replaced with an approved surface material.

8.3.3 Safety Practices

The use of thin masonite sheets under chairs with rollers is prohibited due to the curl that will develop at the edges of the sheet, causing a tripping hazard for both the chair and the occupant. Oversize rollers should be fitted on chairs which are used on rugs.

At least three feet should be allowed as chair space between the back of one desk and any obstruction behind the chair.

Flammable or toxic office chemical supplies will be stored in metal cabinets. When stored, flammable or toxic chemicals will be limited to minimum quantities necessary for the operation conducted in the office, neatly arranged, and properly marked. The amount stored should be limited to a one week supply.

Heavy equipment and files will be placed against walls or columns.

8.3.4 Proper Disposal of Material

Bulk computer/recyclable paper and bulk paper/trash, such as books, loose leaf binders, telephone books, and discarded bond paper thicker than 1/2 inches should be packed in 18"x12"x12" boxes, FSN 8115-00-179-0579, available from stock.

The Center has a contractor lighting crew to replace bulbs/tubes and this service should be used. When such items are replaced by NASA personnel, the bulbs/tubes should be placed in identified special containers and set aside for appropriate pickup. Do not dispose of this glass in regular waste paper receptacles.

Broken glass, small pieces of metal, and razor blades should not be disposed of in regular waste paper receptacles.

To prevent occupational dermatitis, materials remaining after servicing copying machines must be put into containers. Material spills on carpets or floors shall be immediately cleaned in order to eliminate slip hazards.

8.4 PERSONNEL CERTIFICATION AND QUALIFICATION REQUIREMENTS

It is LaRC policy to certify workers performing tasks which could be potentially hazardous to either the individual or coworkers if applicable safety precautions are not observed. These requirements vary with the type of activity being performed, and consequently are described in detail within the various sections of the LaRC Safety Manual dealing with the specific topic/hazard. The overall process is summarized in this section for clarity and emphasis.

8.4.1 Certification Requests

It is the responsibility of each first line supervisor to initiate the certification process. All certifications are to be requested on NASA Langley Form 66, except for safety operators which are requested on OSEMA Organizational Form N 201, "Safety Operator Appointment" (see LPR 1710.10, "Safety Clearance Procedures (Lockout/Tagout)"). If any employee suspects a particular task requires worker certification, the employee should bring it to the attention of the line supervisor or the Safety Manager.

8.4.2 Qualification Requirements

The requesting initiator will indicate prior education, training, or experience directly related to the activity involved. This information will assist the qualifying official to determine the need for new training prior to issuance of the certification. Training requirements and arrangements should be verified through the Safety Manager or personnel within the OSFA, OSEMA, if not prescribed in the indicated LPRs.

8.4.3 Record of Certification

Each certified worker will be issued a certification card which should be on the person whenever performing the function requiring certification. Special equipment operators will have their certification typed on their Government vehicle licenses. In all cases, the certifying or authorizing official will be the Safety Manager, assisted in this process by designated line managers, qualifying officials, and the Industrial Hygienist or Health Physicist as appropriate. Further, the Safety Manager will assure a listing of certified personnel and notification of line management of extension or recertification due dates.

8.4.4 Certification Requirements

Current work activities requiring certification are listed on the next page. Questions on certification status, or need for other types, will be addressed to the Safety Manager.

Table 8.1**Work Activities Requiring Certification**

<u>Type Work</u>	<u>Prescribing Document</u>	<u>Request Form</u>
Safety Operator	LPR 1710.10	OSEMA Form N201
Ionizing Radiation	LPR 1710.5	NASA Langley Form 66
Nonionizing Radiation	LPR 1710.8	NASA Langley Form 66
Chemical	LPR 1710.12	NASA Langley Form 66
Pyrotechnic	LPR 1710.7	NASA Langley Form 66
High Worker	LPR 1740.2	NASA Langley Form 66
Hardware Handlers	LPR 1740.6	NASA Langley Form 66
Aerial Manlift Operator	LPR 1740.6	NASA Langley Form 66
Confined Space Monitor	LPR 1740.2	NASA Langley Form 66
Commercial Driver's License	Virginia State Law	State Permit Required

8.5 EARPHONES, PORTABLE RADIOS, AND TAPE PLAYERS

Radios or players with a single headphone are acceptable in office or nonhazardous locations. Use discretion when using dual headphones with player units while jogging, operating a vehicle, or in the workplace. One ear should remain uncovered so that warning noises, conversation, etc., can be received. The single and the dual headphone devices can both be dangerous as the unsecured cords may become entangled in rotating machinery or caught on objects and projections, leading to a mishap and possible injury.

8.6 PORTABLE ELECTRIC HEATERS

Portable electric heaters will be permitted at LaRC for emergency use during major heating failures, facility rehabilitations, or for health reasons with the written approval of the LaRC Safety Manager. All unapproved portable heaters should be forwarded to the OSFA for disposal.

8.7 PHYSICAL LIFTING REQUIREMENTS

Back and muscular injuries comprise a major part of the LaRC accident/injury data base. Reference weights for moderate lifting provided by the Department of Labor and Office of Personnel Management are 20 to 50 lbs. and 15 to 44 lbs., respectively. A normal lifting standard of 15 to 50 lbs. has been established for LaRC.

Personal physical requirements may lower this standard as individuals should never lift more than their own capability. When lifting loads greater than 50 lbs., extreme caution should be taken. Additional manpower or mechanical advantage should be used whenever possible.

Safe lifting is another element of lifting technique. Awareness material and training is available through OSFA, OSEMA.

8.7.1 Lifting

Observe the following safe lifting practices:

- Stand as close as possible to the load.
- Bend at the knees, keeping the back straight.
- Firmly grasp the load.
- Lift with the legs.
- Hold the load as close as possible to the body.

8.7.2 Moving or Carrying

When moving/carrying items:

- Don't change grips unless the weight is supported.
- Avoid twisting the body.
- Assure clear vision, particularly when ascending or descending stairs.
- Push, don't pull, loads.
- Shoulder carry bags/sacks, braced by hand.
- Roll barrels when manually moving them.

8.7.3 Unloading

When unloading items:

- Bend the knees to lower the load.
- Make sure all body parts are clear when lowering a load.
- Lower the load then slide it into tight places.

- Lower the load by resting it on its edge and pushing it forward.
- Make sure the load is secure before leaving it.

8.8 FIRST AID KITS

To ensure that all LaRC and supporting contractor personnel have access to first aid treatment, the LaRC clinic and medical personnel are available daily from 7:00 a.m. to 3:30 p.m. During the remainder of each workday, advanced-life-support certified paramedics are on duty and available at Facility 1248, the Fire Station.

First aid kits are not authorized in LaRC facilities and should be forwarded to OSFA, OSEMA. All personnel requiring first aid treatment will report to Facility 1149, "First Aid," from 7:00 a.m. to 3:30 p.m. during the day shift and to Facility 1248 at all other times. It is very important that all incidents are reported and treated professionally. Individuals treated by paramedics in Facility 1248 should report to the Medical Center, Facility 1149, at their earliest convenience to assure that medical records are annotated.

8.9 EMERGENCY LIGHT REQUIREMENTS

Emergency lights are to be defined and placed according to the Fire and Life Safety Code. Section 6.3 of LPR 1710.11, "Fire Protection Program," contains detailed discussion of battery powered emergency lighting.

Installation, removal, or relocation of emergency lights must be approved by OSFA, OSEMA. All Facility Coordinators should be aware of the routine preventive maintenance cycle for these critical systems.

8.10 OCCUPANCY PERMITS

Section 6.4 of LPR 1710.11, "Fire Protection Program," contains detailed discussion of occupancy permits.

Chapter 9**9. TRAILER SAFETY PROGRAM****9.1 GENERAL**

This Chapter sets forth the LaRC Trailer Safety Program. All trailers, except office and/or laboratory, are under the control of the LaRC Transportation Officer.

The four classifications of trailers included in this program are:

- Compressed Gas (Tube).
- Liquid Storage (Tank).
- Office and/or Laboratory.
- Other (Van Type, Instrument, Cargo Containers, etc.).

Tractors supporting the movement of these trailers must comply with Virginia State roadworthiness requirements. Notification of planned trailer movement must be provided the Transportation Officer and the OSFA, OSEMA, 30 days prior to the expected date of trailer movement.

9.2 COMPRESSED GAS TRAILERS

Permanent and mobile compressed gas trailers at LaRC are used in support of various research activities. Necessary recertification and roadworthiness requirements are defined in this Chapter.

All permanent trailers at LaRC are to be configured in accordance with criteria specified in Appendix C.

9.2.1 Mobile Compressed Gas Trailers

Mobile compressed gas trailers are to be included in the LaRC roadworthiness program, which provides for inspection according to Virginia State requirements. Inspection is to be coordinated by the trailer loanee through the Transportation Officer, extension 43440.

9.2.2 Gaseous Tube Trailers

Gaseous tube trailers are fabricated in accordance with the American Society of Mechanical Engineers (ASME) or DOT design criteria. Trailers fabricated in accordance with DOT criteria require recertification every five years. At LaRC, DOT type permanent and mobile nitrogen storage trailers also require recertification every five years and no trailer may be filled with gas if it has exceeded the five year recertification period. Recertification information will be maintained by OSFA, OSEMA, who will notify the trailer loanee three months prior to required certification. The loanee is required to submit NASA Langley Form 69, "LaRC Work Request," to Work Control for funding for recertification and major roadworthiness repairs. Recertification information and records relating to recertification will be maintained by

the Systems Engineering Competency. Roadworthiness repairs will be performed by the office of the Transportation Officer.

9.3 LIQUID STORAGE TRAILERS

Permanent and mobile liquid storage trailers used in support of research activities at LaRC have the same configuration and roadworthiness requirements as those defined for compressed gas trailers.

The structural integrity of liquid storage trailers for cryogenics is provided through inspection as defined in LPR 1710.40, "Safety Regulations Covering Pressurized Systems," Appendix A. These trailers and all other liquid storage trailers will have the required vessel inspection criteria included in the LaRC computerized maintenance program.

9.4 OFFICE AND/OR LABORATORY TRAILERS

Trailers used for office and/or labs at LaRC are controlled by OLM as set forth in LAPD 8800.15, "Facilities Utilization Program." The Facility Utilization Manager, Capital Investment Planning Office, SEC, is responsible for the configuration and movement of these trailers. Each trailer unit will have a Facility Coordinator designated for normal daily management. These units are subject to the annual safety and health audits, fire inspection, and evacuation drills performed by OSFA, OSEMA. Office and laboratory trailer installation must comply with policy presented in Appendix C.

A number of trailers have been modified to function as temporary restrooms. These trailers are controlled by OLM, and must comply with Appendix C requirements.

Section 8.4 of LPR 1710.11, "Fire Protection Program," contains detailed discussion concerning use of trailers.

9.5 OTHER TRAILERS

Van type, flat bed, instrument, and other trailers which are mobile will be included in the LaRC roadworthiness program. Permanent trailers of this type require roadworthiness inspection prior to movement. This inspection is to be coordinated with the Transportation Officer, OLM.

Cargo trailers and Conex containers that have been made immobile by configuration require OSFA, OSEMA, approval before installation. Present trailer siting requirements will be used as appropriate. This will be determined by OSFA, OSEMA.

CHAPTER 10**10. COMPRESSED GASES****10.1 GENERAL**

Any material that is under pressure can be dangerous if it is not handled properly. If the material is a compressed-gas it may be flammable, explosive, reactive, toxic or a combination of these characteristics. Because of the hazards associated with compressed gases, it is important to know their hazardous properties and how to safely handle their containers (the gas cylinder).

10.2 IDENTIFICATION

Before handling any compressed-gas cylinder, identify the cylinder by its identification and hazard labels, not its color (different manufacturers use different color codes). Check the label for hazards, and read the Material Safety Data Sheet instructions on handling and protective equipment. Each cylinder should have a label showing its maximum approved pressure and a current test date. Cylinders missing this information should not be handled.

10.3 HANDLING CYLINDERS

Only trained persons will unload cylinders. Before accepting compressed-gas cylinders, inspect them for damage or leaks and continue inspecting them at regular intervals. Move damaged or leaking cylinders to a safe, isolated storage area since a ruptured cylinder can literally become a rocket with the force to blast through a concrete wall. When moving cylinders, use special cylinder hand trucks, with the cylinder lashed to the cradle and standing as upright as possible. Avoid dropping, banging or rolling cylinders and keep them away from fire, heat and sparks.

When using cylinders, open the valve slowly with the discharge end of the cylinder pointed away from personnel. Ensure the hoses and connections are clean and in good condition before the cylinder is used. When cylinders are not in use, screw down the protective metal cap to the last thread. Empty cylinders should be labeled as such and kept separate from full ones.

10.4 STORAGE

Compressed-gas cylinders should not be stored in temperatures above 125°F(51.7 °C), in direct sunlight, or subjected to artificially created low temperatures. Keep cylinders upright, secured with a chain or cable, in a safe, fire-resistant, well ventilated area, and away from heat sources, combustible materials and electrical wiring.

Group cylinders with others of the same contents, and store empty cylinders separately. Avoid using cylinders in confined spaces. Rotate stock, using older cylinders first.

10.5 COMPRESSED GASES REQUIRING SPECIAL HANDLING

The following compressed gases require special handling:

- Oxygen, while not flammable in itself, increases the tendency of combustible materials to burn or explode. Keep oxygen cylinders away from combustible or flammable materials and fire hazards, including oil or grease on your hands, clothes and work area. Oxygen should not be used in place of compressed air.
- Chlorine and fluorine are highly corrosive and irritating gases, and will attack many materials. When mixed with acetylene and exposed to light, they may explode. Chlorine will form corrosive hydrochloric acid in water, eating into iron or steel equipment. A gas mask and other protective equipment should be available for use in case of a leak.
- Ammonia is also highly corrosive. When using it, ensure a gas mask and other protective equipment is readily available.
- Acetylene and hydrogen are both highly explosive gases that must be handled with extreme caution. Hydrogen escapes easily from threaded fittings that are not completely tight, and such leaks can ignite spontaneously from the friction of the escaping gas. Hydrogen has no odor to warn of a leak. Acetylene bottles should always remain upright in order to prevent the possibility of gas leakage and/or explosion.

CHAPTER 11**11. LASERS**

Lasers are commonplace today. As with all electronic equipment in use, microchips and other components have made these items much smaller, lighter, and more powerful. In the past, diode lasers were considered relatively safe to the eye due to their low power output. However, these devices are now being manufactured with power outputs that are extremely hazardous to the eye and workers should remain alert to this hazard when using these very small and seemingly harmless laser devices. Eye protection devices specifically designed for protection against radiation from Class 3b and Class 4 laser systems shall be administratively required. Their use shall be enforced when engineering or procedural and administrative controls are inadequate to eliminate potential exposure in excess of the applicable maximum permissible exposure.

Contact the LaRC Radiation Officer for answers to questions concerning lasers, laser operations, laser safety training, and laser eye protection. More information regarding laser use at LaRC may be found in LPR 1710.8, "Nonionizing Radiation".

LPR 1740.2 APPENDICES

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION

SYSTEM	LEGEND	COLOR WARNING	REMARKS
1. ENVIRONMENTAL CONTROL SYSTEMS			
Air Conditioning Ducts			
Supply	A/C SPLY		
Return	A/C RTN		
Fresh Air	FR AIR		
Exhaust	EXH AIR		
Heating Ducts			
Supply	HTG SPLY		
Return	HTG RTN		
Fresh Air	FR AIR		
Exhaust	EXH AIR		
Dual Temperature Ducts			
Supply	DUAL TEMP SPLY		
Return	DUAL TEMP RTN		
Fresh Air	FR AIR		
Mechanical Ventilation			
Supply	MECH VENT SPLY		Color warning shall be applied as applicable.
Exhaust	MECH VENT EXH		Color warning shall be applied as applicable.
Hot Water Heating (Low & Med. Temp.)			
Supply	HTG SPLY ____ F		Gray color warning for temperature above 200 ⁰ F.
Return	HTG RTN ____ F		Gray color warning for temperature above 200 ⁰ F.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Chilled Water Cooling Supply Return	CH WTR SPLY____F CH WTR RTN____F		
Cryogenic Piping			Gray color warning for temperature over 200 ⁰ F and under 0 ⁰ F.
Hot Water Heating (High Temp.) Supply Return	HI TEMP SPLY____F HI TEMP RTN____F	Gray Gray	Identify over 200 ⁰ F.
Steam Piping, Heating & Process Steam Condensate	STEAM____PSI____ F COND RTN	Gray Gray	Identify if above 200 ⁰ F. Identify if above 200 ⁰ F.
Miscellaneous Piping Boiler Feed Water Boiler Make-up Water Condenser Water In Condenser Water Out	BLR FD WTR____PSI BLR MK WTR COND WTR IN COND WTR OUT		Gray color warning for temperature above 200 ⁰ F.
2. Plumbing Systems			Drainage, Waste, and vent piping are used as defined in the National Planning Code.
Acid Line Acid Waste Drinking Water, Chilled Domestic Hot Water Non-Potable Water Sanitary Drain	ACID____% ACID WST CH DKG WTR DOM HT WTR NON-POT WTR SANI DRN	Blue Brown Brown	Insert chemical formula and concentration in percent.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Stack Vent Industrial Waste Water Main	STK VNT IND WSTE WTR MAIN____PSI		Color warning shall be applied as applicable.
3. Drainage Systems			
Sanitary Sewer Storm Sewer Combined Sewer	SANI SWR STRM SWR COMB SWR	Brown Brown	
4. Fire Protection System			
Fire Main Sprinkler Piping Carbon Dioxide Alternative Gas Agents	FIRE MAIN____PSI SPKLR SYST CO ₂ FIRE PROT FM 200/Inergen	Red Red Red Red	Color warning and legend not applicable to fire hydrants.
5. Electrical Systems			
Lighting Power	ELECT LTG____V ELEC PWR____V		Indication of voltage and blue color warning for voltages 600V and above. Indication of voltage and blue color warning for voltages 600V and above. All 220V and above panels shall be identified as such.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
6. Compressed Gas Systems			Gray color warning for line pressures of 150 PSI and above.
Compressed Air	AIR SHOP_____PSI		
Shop	AIR BRTHG_____PSI		
Breathing	AIR INSTR_____PSI		
Instrument	AIR DSL STG_____PSI		
Diesel Starting	COMP GAS	Green	
Oxygen	O ₂ _____PSI	Green	
Liquid Oxygen	LOX_____F_____PSI	Gray	
Carbon Dioxide	COMP GAS CO ₂	Gray	
Nitrogen Gas	COMP GAS N ₂ _____PSI		
7. REFRIGERANT SYSTEMS			
Ammonia	REFRG NH ₃ No. 17	Brown	
Carbon Dioxide	REFRG CO ₂ No. 744	Gray	
Methyl Chloride	REFRG CH ₃ Cl No. 40	Yellow	
Halocarbons	REFRG No. _____	Gray	Insert refrigerant number.
Sulfur Dioxide	REFRG SO ₂ No. 764	Gray	
8. SECONDARY COOLANTS			
Brines			
Sodium Chloride	BRINE NaCl_____%		Insert concentration in percent.
Calcium Chloride	BRINE CaCl_____%		Insert concentration in percent.
Inhibited Glycols			
Ethylene	INH ETHY GLY	Yellow	
Propylene	INH PROPY GLY	Yellow	

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Concluded

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Halocarbons			
Refrigerant No. 11	BRINE R-11	Gray	
Refrigerant No. 12	BRINE R-12	Gray	
Refrigerant No. 30	BRINE R-30	Gray	
Refrigerant No. 1120	BRINE R-1120	Gray	
9. FUEL SYSTEMS			
Aviation Gasoline	AV GAS__OCT	Yellow	Insert API Octane No.
Diesel Fuel	DIESEL FUEL	Yellow	
Jet Fuel	JET FUEL JP__	Yellow	Insert API Identification No.
Heating Fuel	FUEL OIL NO__	Yellow	Insert API Identification No.
Navy Special Oil	NAV SPCL FUEL	Yellow	
Natural Gas	NAT GAS__PSI	Yellow	
Motor Gasoline	MO GAS__OCT	Yellow	Insert API Octane No.
10. MISCELLANEOUS SYSTEMS			
Dust Collection	DUST COLL		
Laboratory Gas	LAB GAS__PSI		
Snow Melting	SNO MLTG		
Vacuum	VAC	Gray	
Lab Exhaust Systems	LAB EXH SYST		Color warning shall be applied as applicable

Appendix B

**CRITERIA FOR SECURING PERMANENT STORAGE TRAILERS
(GASEOUS AND LIQUID)**

1. Support piers should be eight-inch by 16-inch masonry blocks, resting on a 16-inch by 16-inch concrete slab that is at least four inches thick. Pier spacing will be at four locations (two front and two back).
 2. *Provide at least six 1/2-inch diameter sod-screws in soil anchor tiedowns with four near the corners and augered at least three feet in the ground. In locations where concrete exists, 3/4-inch concrete anchor bolts will be used. (Contact the SEC for details.) Turnbuckles will be used at each hold down location. In locations where asphalt exists, the material will be removed to earth level and sod-screws installed as described above.
 3. A minimum spacing of at least six feet should be maintained between adjacent structures.
- * This requirement is applied where the trailer size and configuration provides an unacceptable risk. This risk assessment is provided by the OSFA, OSEMA.

Appendix C

OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES

SITING REQUIREMENTS

1. Footings and piers will be installed on solid ground. This may require removal of topsoil to provide a firm and level surface.
2. Support piers will be eight-inch by 16-inch masonry blocks, double wide. Pier spacing will be 10 feet or less, center to center. Blocks will be placed on 16-inch by 16-inch by four-inch concrete slabs. Slabs are not required on asphalt or concrete surfaces four inches or greater in thickness.
3. Place trailer on piers and shim so floor is level. Shims will be wood or metal with care being taken so as not to damage masonry blocks.
4. Skirt enclosure will be provided on all trailers with exposed plumbing. Skirts on all other units are desirable but optional.
5. Provide three-foot wide landing equipped with stairs and handrails at exits. Appropriate sidewalks will be installed to provide safe walkways.
6. A minimum spacing of 25 feet will be maintained between adjacent trailer units or complexes. (A trailer unit is defined as a single trailer. A trailer complex is defined as two or more units that are designed to be tied together.) A minimum spacing of 25 feet is required between a trailer unit/complex and permanent facilities.
7. Trailer tongues will be removed or adequately covered to protect employees from walking or tripping hazards.
8. Digging Permits:

Digging permits are required for all digging to include:

- All tiedown penetrations.
- All underground utility installations.
- Topsoil removal.

Digging permits are obtained by calling the Underground Utilities Coordinator.

OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES-

Continued

9. Tiedowns:

- Soil anchor tiedowns will be provided on all single trailer units. Tiedowns will be located at each corner and at the midpoint of the sides.
- Soil anchor tiedowns will be used on complexes (two or more units) in a manner to protect the units from high winds. Tiedowns will be provided at each corner of the unit and on the sides at midpoints. Tiedowns should not exceed 20 feet between anchor points.
- All penetrations for tiedowns require a LaRC "Digging Permit." (See Chapter 2, Figure 2-2.)

INTERIOR MODIFICATION

1. Walls, ceilings, and new partitions will be of noncombustible construction, that is, steel studs and sheetrock.
2. Exterior door locks will be modified to be compatible with the LaRC key system.
3. Double exits with clear access routes will be provided for each trailer unit.
4. Fire extinguisher(s) will be installed in accordance with appropriate National Fire Protection Association (NFPA) Standards.
5. Laboratory trailers shall have smoke detectors.

HEATING SYSTEMS

No trailer unit or complex will be installed with gas or fuel oil heating systems. Only electrical resistant or compressor-type heat will be used.

WATER AND SANITARY CONNECTIONS

Water and sanitary connections for LaRC trailers will be installed in accordance with the Building Officials Code of America (BOCA) Basic Plumbing Code, most recent edition.

FRESH AIR REQUIREMENTS

Fresh air requirements shall comply with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard for Ventilation for Acceptable Indoor Air Quality, most recent edition.

**OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES-
Concluded**

RESTROOMS

1. Restrooms will be provided with not less than a 60 cfm exhaust fan.
2. Water heaters will be equipped with thermal and pressure relief devices.

ELECTRICAL INSTALLATION

The electrical utilities and the telephone service for all trailer installations will be installed in accordance with the National Electric Code (NEC), most recent edition.

Specific Requirements

1. All exposed wiring will be installed in conduit.
2. All wire will be 12 gage copper or larger.
3. All electrical fixtures and equipment will be grounded.
4. The metal shell and frame of all trailers will be bonded to a common ground.
5. Direct burial cable will not be installed above ground.
6. A fused disconnect or circuit breaker located outside the trailer will be used as a main disconnect for each trailer.
7. A local protective signaling system will be installed in all office/laboratory trailers in accordance with NFPA. The signaling system will be connected directly to the Central Fire Alarm Panel in Facility 1248. This system will be operational before the trailers are occupied.